

Original Research Article

Status of anemia among the tribal children in West Bengal

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ABSTRACT

Background: Anemia is a major public health problem worldwide. School children are more vulnerable to this disease due to their rapid growth need of high iron. Therefore, it is a critical health concern because it affects growth and physical performance. This study was undertaken to investigate the prevalence of anemia among different areas and sub-caste of tribal school children in West Bengal.

Methods: Complete hemogram was performed on Sysmex (KX-21) automated cell counter. Haemoglobin analysis was done by high performance liquid chromatography (HPLC, from Bio Rad Variant II). Ferritin estimation was done by ELISA based method. A software (Thaltribe) was prepared to record and maintain the data of the screened population.

Results: Total number of school students from all the districts of West Bengal included in this study was 45887. Among the total population 49.88% were found to carry low Hb and 28.45% had low ferritin. Among the population who had normal ferritin (N=32832), there were 46.59% (N=15298) carrying low Hb. Among total 15298 cases who had low Hb with normal ferritin level, 10741 (70.21%) remained undiagnosed who were not detected to be thalassaemia carrier or thalassaemia disease (HPLC normal) and also did not carry alpha globin gene mutation.

Conclusions: On the contrary to the common belief that iron is the main source of anemia, it was observed in this study that around 25% of anemic children did not have iron deficiency. This group requires further evaluation to investigate the reason of anemia.

Keywords: Anemia, Iron deficiency Anemia, Ferritin, Tribes

INTRODUCTION

Anemia is a major public health problem worldwide. According to the WHO, there are two billion people with anemia in the world and half of the anemia is due to iron deficiency.¹ Anemia is a late indicator of iron deficiency, so it is estimated that the prevalence of iron deficiency is 2.5 times that of anemia.^{1,2} Anemia and iron deficiency lead to substantial physical productivity losses in adults.² Iron deficiency during pregnancy is associated with maternal mortality, preterm labour, low birth-weight and infant mortality.² In children, iron deficiency affects

cognitive and motor development and increases susceptibility to infections.³ Various preventive measures have been taken by Government of India to prevent iron deficiency anemia among susceptible population. However, in spite of all these even today high level of anemia is still prevalent especially among pediatric age group and reproductive age group.¹⁻³ School children are more vulnerable to this disease due to their rapid growth need of high iron. Therefore, it is a critical health concern because it affects growth and physical performance. It is estimated that two billion children are affected with iron deficiency anemia worldwide.⁴ There are multiple causes

of iron deficiency anemia including inadequate iron intake, respiratory infections, Helminthes' infestation, malaria, diarrhea, vitamin A and vitamin C deficiencies. Scheduled tribes (STs) are the main victims of anemia (57.3%) when compared with other ethnic groups.⁵ The large Indian tribal population is multi-ethnic and divided into subgroups. However, studies regarding status of iron deficiency among tribes including a large study population are very few. This study was undertaken to investigate the prevalence of anemia among different areas and sub-caste of tribal school children in West Bengal.

METHODS

The study was done as a part of a project entitled 'epidemiological study on anemia, sickle cell disease and other mutant hemoglobin amongst the tribal community in West Bengal'. Students from residential tribal schools from all the districts of West Bengal were included in the study. The study was conducted during the period of March 2018 to February 2020. Both male and female students and age group ranging from 11 years to 18 years were included.

Informed consent was taken from the students and/or parents.

Detailed history regarding caste, residence, consanguinity, family history of thalassemia was taken from each student and examination for pallor, jaundice and splenomegaly were done.

Two ml of EDTA blood samples were collected from each student. Complete hemogram was performed on Sysmex (KX- 21) automated cell counter. Haemoglobin analysis was done by high performance liquid

chromatography (HPLC, from Bio Rad Variant II). Ferritin estimation was done by ELISA based method. A software (Thaltribe) was prepared to record and maintain the data of the screened population.

RESULTS

Total number of school students from all the districts of West Bengal, included in this study was 45887. The age group ranged from 11 years to 18 years with the mean age of 14.7 years. There were 34% female and 64% male. The total study population was sub-divided in three age groups and subsequently their hematological parameters were analyzed (Table 1). Among the total population 49.88% were found to carry low Hb. Mean hemoglobin (Hb) percentage among total population was 11.72 gm/dl. Among the age groups 11 years, 12-14 years and 15- 18 years, the mean Hb were found to be 11.47 gm/dl, 11.57 gm/dl and 11.86 gm/dl respectively. There were 49.88% of total population who had low Hb and 50.12% had normal Hb. Ferritin was found to be low among 28.45% of the total population and normal among 71.55%. Mean ferritin was found to be lowest (58.61 ng/ml) among 15- 18 years age group and highest (67.49%) among the 11 years age group. It was found that the maximum frequency of individuals (60.93%) with low Hb was found among the age group of 12-14 years (Table 2). Among the total population low ferritin was found to be most prevalent among 15-18 years of age group with a frequency of 31.44% (Table 2).

Further analysis revealed that among the population who had low ferritin (N=13055), 58.13% had low Hb and 41.71% had normal Hb (Table 3). It was interesting to find that among the population who had normal ferritin (N=32832), there were 46.59% (N=15298) carrying low Hb.

Table 1: Hematological indices of the study population.

Hematological indices	11 years	12-14 years	15 -18 years	Total population
Total number	2058	18910	24919	45887
Hb% (mean)	11.47	11.57	11.86	11.72
MCV (mean)	82.37	81.59	81.86	81.77
Ferritin (mean)	67.49	59.91	58.61	59.54

Table 2: Hb and ferritin assessment among the study population.

Assessment	11 years (N=2058)		12-14 years (N=18910)		15-18 years (N=24919)		Total population (N=45887)	
	Number	%	Number	%	Number	%	Number	%
Low Hb%	975	47.38	11521	60.93	10392	41.70	22888	49.88
Normal Hb%	1083	52.62	7389	39.07	14520	58.27	22992	50.12
Low ferritin (<30)	247	12.00	4974	26.30	7834	31.44	13055	28.45
Normal ferritin (>30)	1811	88.00	13936	73.70	17085	68.56	32832	71.55

Table 3: Comparison of ferritin and Hb level (normal and low).

Normal ferritin population	11 years (N=1811)		12-14 years (N=13936)		15-18 years (N=17085)		Total population (N=32832)	
	Number	%	Number	%	Number	%	Number	%
Normal Hb	981	54.16	5636	40.44	10921	63.92	17537	53.41
Low Hb	831	45.88	8301	59.56	6166	36.09	15298	46.59
Low ferritin population	11 years (N=247)		12-14 years (N=4974)		15-18 years (N=7834)		Total population (N=13055)	
Normal Hb	104	42.10	1753	35.24	3609	46.06	5466	41.71
Low Hb	144	58.29	3220	64.73	4226	53.94	7590	58.13

Table 4: Analysis of the population with low Hb and normal ferritin.

Analysis	11 years (N=831) (%)		12 -14 years (N=8301) (%)		15-18 years (N=6166) (%)		Total (N=15298) (%)	
Average Hb	10.65		10.88		10.76		10.78	
Thalassaemia carrier	110	13.24	899	10.86	639	10.36	1648	10.77
Beta carrier	48	5.77	481	5.79	392	6.36	921	6.02
HbE carrier	28	3.36	149	1.79	59	0.95	236	1.54
HbS carrier	32	3.85	250	3.01	162	2.62	444	2.90
HPFH carrier	0	0.00	4	0.04	3	0.04	7	0.04
Hb Lepore carrier	1	0.12	3	0.03	3	0.04	7	0.04
Hb D carrier	1	0.12	1	0.01	1	0.01	3	0.01
Other carrier	0	0.00	11	0.13	19	0.30	30	0.19
Thalassaemia disease	36	4.33	226	2.72	112	1.81	374	2.44
HbE disease	36	4.33	199	2.39	97	1.57	332	2.17
Other disease	1	0.12	27	0.32	15	0.24	43	0.28
HPLC normal	685	82.42	7176	86.44	5415	87.81	13276	86.78
Alpha single del	59	7.09	572	6.89	472	7.65	1103	7.21
Alpha double del	72	8.66	813	9.79	547	8.83	1432	9.36

This group (N=15298) who had normal ferritin level with low Hb was subjected to further analysis to investigate the potential influences for reduced Hb level in spite of carrying normal ferritin values (Table 4). The mean Hb among this group was 10.78 gm/dl. HPLC result showed that among them (N=15298) there were 10.77% (N=1648) who were found to be beta thalassemia carrier, 2.44% were found to carry thalassemia disease and 86.78% were found to have normal HPLC values. Among the total 1648 thalassaemia carriers (10.77%) found by HPLC, the prevalence/frequency of beta carriers were found to be the highest (6.02%) followed by HbS (2.90%) and HbE (1.54%) carriers. There were 332 cases (2.17%) who were found to have HbE disease.

The group (N=13276) who were found to have normal ferritin level with low Hb but showed normal HPLC parameters were further subjected to molecular investigation by GAP PCR to detect presence of alpha globin gene deletion mutation. It was found that among 13276 individuals, 1103 and 1432 had single alpha globin gene deletion and double alpha globin gene deletion

respectively along with 10741 who did not carry alpha globin gene deletion (Table 4). Among total 15298 cases who had low Hb with normal ferritin level, 10741 (70.21%) remained undiagnosed who were not detected to be thalassaemia carrier or thalassaemia disease (HPLC normal) and also did not carry alpha globin gene mutation. Thus out of total population (N=45887) there are 23.4% (N=10741) with low Hb but remains undiagnosed after ferritin estimation, HPLC analysis and alpha thalassemia screening.

DISCUSSION

Anemia is a widespread public health problem associated with an increased risk of morbidity and mortality, especially in pregnant women and young children.¹ Globally 1.62 billion people are anemic, while among the preschool children the prevalence of anemia is 47.4%. Nutritional anemia in South Asia accounts for nearly half of global cases of anemia. In India, anemia continues to be the major health problem in young children, adolescent girls and pregnant women.^{4,5} In India, about 89 million

children are anemic. The highest prevalence of anemia was seen in children <10 years.⁴ Iron deficiency is one of the most common causes of anemia. Besides iron, other nutrients such as vitamins A, E and C also play key role in formation and protection of red blood cell (RBC) by stimulating stem cells as well as by activating a number of antioxidant enzymes. Therefore inadequacy of any of these micronutrients may lead to anemia in the vulnerable sections of population. Studies have shown that children are more vulnerable to the risk of iron deficiency anemia. The prevalence of iron deficiency anemia is the highest among preschool children. In this age group, body grows rapidly and requires high-iron-rich and nutritious food that may not be fulfilled by their normal diet. Low economic status, less education and poor health of mothers due to meager dietary intake are the main causes of anemia. Anemia is the most predominant factor for morbidity and child mortality and hence, it is a critical health issue for children in India. Iron deficiency affects cognitive and motor development and increases susceptibility to infections. Tribal population in West Bengal constitutes a significant proportion (5.1%) and the vulnerable group because of lower socio-economic status, poor literacy rate and malnutrition. In a study among a small population of tribal children in West Bengal, conducted by Dolui et al it was shown that around 47% of the tribal children were anemic which is at par with the result in our study.⁶ However most of the studies have not described the iron status of the studied population. In our study, it was interesting to find that there were a significant number of population who had normal ferritin but low Hb. We also found that there were 5466 (around 11.8%) children among the total population who were found to have iron deficiency state having normal Hb but low Hb. This may be due to lack of proper nutrition which is adequate to maintain normal Hb level but not enough to replenish the iron store. No other study is found reporting the similar observation. This finding is especially important because this group requires special care and iron supplement may be given to this group. The most interesting observation in this study was that there were 10741 (23.4%) individual who remain undiagnosed who were not detected to have neither any form of thalassaemia nor low ferritin but were found to be anemic (low Hb). Similar observation was reported by NHFS-5 (government of India) report as well. The factors like iron metabolism defect, genetic background and other potential reasons for this type of phenotype need to be investigated further.

CONCLUSION

On the contrary to the common belief that iron is the main source of anemia, it was observed in this study that around 25% of anemic children did not have iron deficiency. This group requires further evaluation to investigate the reason of anemia. Impact of other micro nutrient deficiency or any genetic, metabolic disorder responsible for anemia among this group needs to be further investigated.

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Conflict of interest: None declared

Ethical approval: The study was approved by the Institutional Ethics Committee

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